End-to-End Mobility Architecture for Ubiquitous Computing

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Outline

- Background
- Related works of mobile Internet protocols
- Objective
- End-to-End Association-Based Architecture
- Experimental results
- Conclusions

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Background (1)
Future ubiquitous networks

- Many wireless devices
  - Cellular phone, PDA, sophisticated watch, etc.
- Many kind of wireless access providers
  - Their coverage area will overlap with each other.
  - Their networks have quite different features.
    - Cellular service, Wireless LAN service

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Background (2)
Future ubiquitous service

- Many services in ubiquitous networks
  - Web browsing, Radio, TV
  - Medical information including the pulse
  - Location information of children and aged people
- Many scenes that services will be useful
  - Traveling, Commuting

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Background (3)
Requirements

- Mobility management with multi-homing functions becomes a key technology.
  - QoS (Quality of Service) control
  - Security
  - Lightweight
  - Easy deployment

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Related work
mobile Internet protocols (1)

- Mobile IPv4 and Mobile IPv6
  - Mobility extension of IP
  - Provide the transparency and backward compatibility to the transport layer
  - There is a difficulty about multi-homing support.
    - This difficulty comes from layer 3 nature of Mobile IP.

L.4	Transport
L.3	Mobile IP
L.2	Data link

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Related work
mobile Internet protocols (2)

- Mobile SCTP (Stream Control Transmission Protocol)
  - Novel transport protocol
  - Natively supports multi-homing function

  - It is difficult to provide QoS control.
  - Transport layer has many functions, so mobility function should be separated.

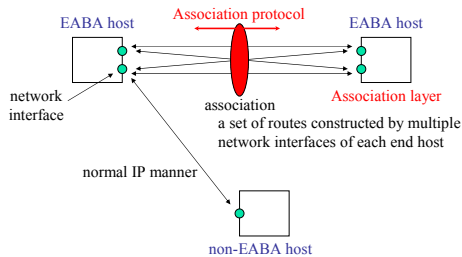| L.4	Mobile SCTP
L.3	Network
L.2	Data link

Objective

- To provide suitable mobility architecture and protocols with multi-homing function
  - QoS control
  - Security
  - Lightweight
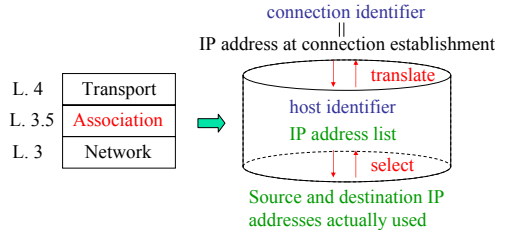 - Easy deployment

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Proposed Architecture (EABA)
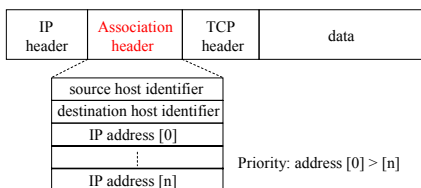
- End-to-End Association-Based Architecture

EABA host — Association protocol — EABA host
network interface
association
a set of routes constructed by multiple network interfaces of each end host
Association layer
normal IP manner
non-EABA host

Association layer

- Manages the association between each end host

connection identifier
||
IP address at connection establishment

L. 4	Transport
L. 3.5	Association
L. 3	Network

translate
host identifier
IP address list
select
Source and destination IP addresses actually used

Association protocol

- Exchanges IP address list currently used with each other.
- The control information is embedded between L.3 and L.4 header as L.3.5 header.
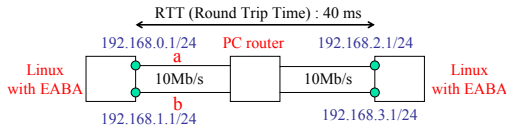
IP header	Association header	TCP header	data

source host identifier
destination host identifier
IP address [0]
IP address [n]

Priority: address [0] > [n]

Evaluation of Prototype implementation

- Prototype
  - Association layer and protocol
  - Linux-2.4 (IPv4)
- Experimental evaluation
  - Effectiveness of our architecture in multi-homing environment
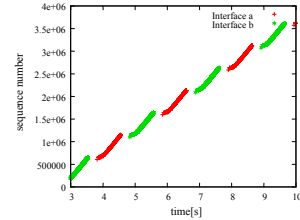 - Availability of existing applications

Experimental environment

RTT (Round Trip Time) : 40 ms

192.168.0.1/24   PC router   192.168.2.1/24

Linux with EABA
a
10Mb/s
b
10Mb/s
Linux with EABA

192.168.1.1/24   192.168.3.1/24

- Each network is separate segment LAN.
- Link a and b are disconnected and connected at the interval of 1 second.

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Experimental results (1)
effectiveness of EABA

- Each host continues communication by using the connected link effectively even if links are disconnected and connected frequently.

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Experimental results (2)
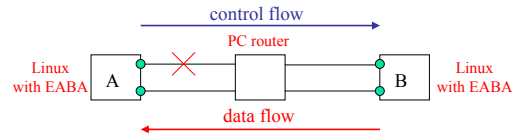## availability of existing applications

Application	Availability
HTTP	○
POP3	○
NFS	○
ssh	○
telnet	○
FTP	×

- Most main applications except FTP can be used.

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Problem on FTP

- FTP uses 2 connections.
  - control connection, data connection
- The direction of each flow is important.

control flow

PC router

Linux with EABA   A   B   Linux with EABA

data flow

- Plan to solve this problem
  - manage all connections between same hosts by one association

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Conclusions

- End-to-End Association-Based Architecture (EABA) for ubiquitous computing
  - This architecture is effective in the multi-homing environment
- Future work
  - improve this architecture
  - perform evaluation in many cases

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